

# Kermit was Right: It's NOT Easy Being Green

(Captain's Log: November 2011 - An Evergreen document, updated as our home evolves)

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It's not easy being Green.... even if you have a Ph.D. in the subject.

Moving to a new home and community in mid-2008 presented a great opportunity to walk the talk (or “eat my own dogfood”, as they say these days). The late-1970s house was an eco-basket-case. To put it more politely, it offered a bounty of that proverbial low-hanging fruit: ancient oil-fired heating system leaking flue gasses, incandescent lighting galore, inefficient appliances, duct insulation that looked like sphagnum moss, you get the idea.... This will be like shooting fish in a barrel, I foolishly assured myself.

What better way to start than to jump on Google and see what the best products are these days? Easier said than done. I quickly learned that one of the largest obstacles to doing the right thing is having too much of the wrong information, and in a form that is inscrutable. Now I finally know what high-schoolers mean by TMI. (No, not Three Mile Island... Too Much Information.) The web provides access to mind-numbing directories of consumer products ranked by energy efficiency. Some of these sites are absolutely choked with columns of data that have little meaning (and thus value) to the main-street consumer. Meanwhile, critical information is often missing (e.g., will this premium-efficiency dishwasher even *fit* in the opening in my kitchen? Can I get service for that brand in this area?). Often, it's difficult or impossible to get side-by-side comparisons. On top of this, some of the resources don't work with the Mac computer, kicking back gibberish (so there goes 15% of computer users right off the top). Computer geeks no doubt have their own special kind of morbid fun designing these resources, but we have a long way to go before consumers with a “change-the-channel” attention span will get what they need from these websites.

Don't give up... said the green angel on my left shoulder. Lighting would be the easy part, I told myself. The house had a mind-boggling 5755 watts of installed lighting load. That's like almost sixty 100-watt light bulbs. I rapidly trimmed the wattage down by about two-thirds (while maintaining or increasing light levels) and am sure that the quality of the lighting quality is much improved and that there is more light now where it's needed. Plenty of incandescent lights could be replaced with compact fluorescents. Dimmable compact fluorescents in the track lights work well enough, and don't have the buzz that vexes most products. The house already had the long four-foot fluorescents in valences around most of the rooms, but they were stuffed with ancient (inefficient) lamps and ballasts; we probably saved 25% by modernizing those, and bye-bye hum and flicker. Oh, the mercury in those

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pesky old fluorescent lamps that should be disposed of in a certain fashion? Well, the guy on the job said he just prefers to “just break ‘em into a trashcan” when no one is looking. No thanks. Our new four-foot tubes contain about 4 thousandths of a gram of mercury each, less than a tenth of what was common for those originally installed in the house. Especially at these low levels, it is particularly pitiful to still see the propaganda about harmful mercury in fluorescent lighting that ignores the fact that far more mercury is mobilized by the fossil fuels consumed to power the less efficient alternatives.

I couldn't help but take the cover off of the nifty new bathroom fan+light that my contractor picked out. To my amazement, I found not one but two 18-watt fluorescents inside, pumping out more light output than a modern 4-foot lamp. I immediately unplugged one of those for a cool 50% savings on top of the savings from converting from incandescent to fluorescent in the first place, and avoiding certain blindness in the process. Tucked between these two macho CFLs was a 4-watt incandescent bulb that was continuously on, thereby negating some of my savings and providing light (day and night) that I didn't need. I suppose it is there for the one hour a year that the power is out. It was gratifying to unscrew it, but most consumers wouldn't have bothered.

Also on the lighting front, I've been particularly pleased with the new tiny 1-watt LED lights in my closet. They let me see my clothes—with good color rendering—for less than a tenth as much energy that a modest compact fluorescent lamp would consume, and low-voltage means plug and play (no need to hire an electrician to install). I also got a nice 1-watt LED task light for my desk, and 3-watt goosenecks as reading lights in the living room. Not something that a fine Italian designer would necessarily be proud of, but a great deal for \$24 and great light. Also got a cool indoor motion sensor that controls lights in a dark hallway. Safer and more efficient—because it responds to both daylight *and* motion—and I don't have to worry about the kids (or me) leaving the light on. Update: it's unreliable, I often find it on in the middle of the light, so reverted to manual operation of this \$75 fancy dual-technology switch. Warranty expired; no returns.

We successfully installed cylindrical reflective “light tubes” to bring daylight into two dark areas. It's nice to not turn on a light during the day. We also put in a good number of dual-paned, argon-filled, low-e skylights which definitely save lighting energy in what was before a dark house in the woods, even in mid-day.

The outdoor lights needed attention, too. We replaced fifteen bright incandescents with compact fluorescents, and installed wrap-around sconces to direct light to where it was needed rather than flooding out every which-way into space. Light pollution is a real issue, especially in the countryside.

I knew full well that another easy thing to do is replace an old fridge with a modern premium-efficiency unit (and send the second, empty unit that we inherited humming in the garage to its happy hunting grounds). One loophole in the carbon system is that if the old ones just end up in a used appliance store somewhere

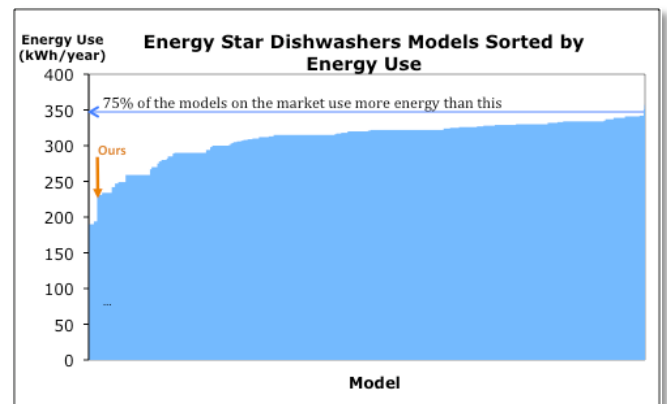
*Evergreen version of November 2011*



(or given to a relative of the contractor who says he's hauling it to the "dump" for you), then you're just exporting your carbon to someone else (probably someone lower-income who really shouldn't be paying the high energy bill for an inefficient unit). To the rescue is our local utility, which not only picks up your old fridge and disposes of it but also pays you \$75 for the privilege (it's a very cost effective way for them to capture energy savings). They guys came with the truck as scheduled. They pick up about 40 units like this every day. They're of course supposed to verify—but didn't in my case—that the units actually run, otherwise the utility shouldn't get any credit for taking fictitious energy and carbon out of the system.

Next round: find new fridge. We hunted and hunted and found the one that had the amenities we wanted and super-good efficiency. Shortly after purchasing, *Consumer Reports* announced a scandal in which some manufacturers of this style unit had falsified their energy test results, claiming Energy Star levels of performance but in fact not delivering them. We didn't happen to get that model, but it left me wondering....

Next, we purchased a super quiet, super efficient dishwasher. The chart shows all the models that meet Energy Star (about the top-25% of everything out there, so there are many worse ones). We managed to end up at the more efficient end of even this spectrum. The most efficient one wouldn't fit in our opening.



I knew full well that the heating system replacement was going to be the most challenging part of the project, but the most rewarding in terms of energy saved. In place was a late-70's oil furnace with disheveled and poorly insulated ducts. In fact, we discovered during the demo process that the exhaust flue pipes had been disjointed since who knows when (installation?), spewing moisture and other combustion products into the home. Out went the furnace, out went the ducts, and out went not one but two electric water heaters (one located in unheated space under the house) and electric heating in one wing of the house that would no doubt have cost a fortune to operate, not to mention particularly high carbon emissions.

We decided to switch the system from oil to propane for heating because the greenhouse-gas emissions per unit of useful energy are 14% lower. (Natural gas would have been far better, but it's unfortunately not available in our area....) The transition could have been smoother.... When the propane provider found the tank installed next to a water pump (somehow ignited off by the building inspector) they refused to provide service because of the explosion hazard. Tank moved. As we're on a gravity-fed neighborhood water supply, we did get a larger pressure tank for the water system, which means less on time and perhaps saved energy (not to mention less noise). On to the next bug-a-boo.

I knew that it was important to find a qualified heating contractor. A quick search of the Air Conditioning Contractors of America (ACCA) website gave me an instant list of certified

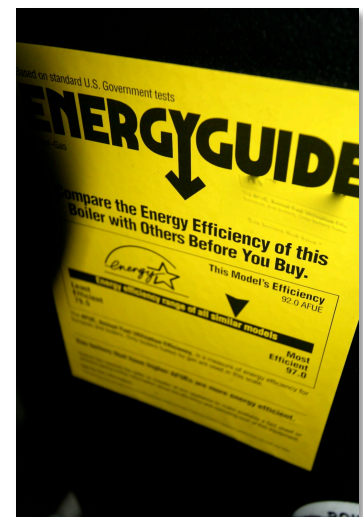
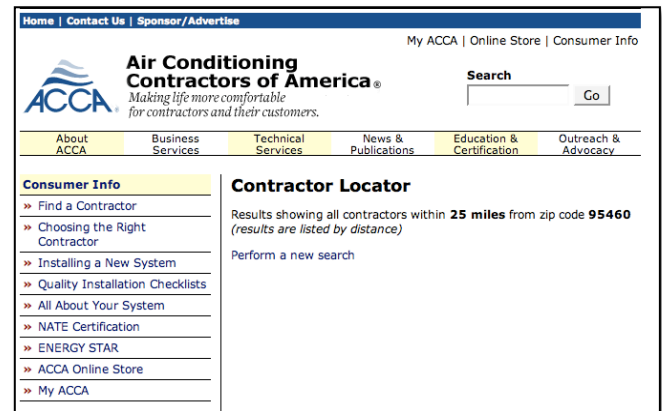
contractors in a 25-mile radius. Answer: zero. Oh well, I went with the best person I could find. We're in a small town, and it took at least 10 hours of phone and email time to line up a contractor who was willing to do the project... and put up with all my pesky questions.

Despite claims to the contrary, size does matter. An undersized heating system will not provide comfort and an oversized one will gobble up more fuel than need be. Not surprisingly, I was the not-so-proud recipient of what we cynically call in the biz "curbside sizing", i.e., the intention of blindly putting in the same sized system as the one that was taken out. Sounds reasonable until you ask how anyone knows if the old one was properly sized in the first place? And, if I'm going to increase the ceiling insulation or put in better windows won't that reduce heating demand and thus required size? Oh, and the new boiler was probably 50% more efficient than the old furnace, so the system could be downsized and still kick out the same amount of heat. None of these questions were contemplated or asked.

We decided to convert from a standard furnace to a super-high-efficiency boiler (with programmable thermostat), which would provide both space heat *and* hot tap water from one unit at about 96% efficiency (versus maybe 65%, on a good day, for the ancient furnace we were dumping). The water storage tank would be inside and so any heat losses would be "useful" in winter and even our often-chilly coastal summers.

The boiler arrived proudly displaying its EnergyGuide label. I did a double-take when the inset EnergyStar label (a label within a label; Give me a break!) showed a heating efficiency that was several percentage points below what I was told it would be (and had seen on the manufacturer website for this very product). It mattered not only in principal, but also because it meant a \$100 difference in the rebate one normally qualifies for from the utility. (OK, actually, in our case we were out of luck because propane providers rarely if ever provide efficiency rebates, and it was outside the remit of our electric provider). After an exchange of emails and digital photos to people in high places, it was determined that the label did not match the actual product it was on and I indeed had the higher efficiency.

I ranted above about the quality of some of the consumer information out there. But some important info isn't there at all. Most people have heard by now about the "leaking electricity" that our appliances consume when they're "off" or on "standby". Well, modern boilers (like the one we got) leak energy, too. How much? There is no standardized, independent information about this and it was like pulling teeth to get self-reported numbers from manufacturers. My contractor hardly knew what I was talking about and wasn't about to go looking for the information for me. One product that I was on the





verge of buying had an amount of leaking electricity equivalent to a 30-watt light bulb running day and night (according to the technical support desk at the manufacturer). That would be about as much energy as a modern super-energy-efficient fridge; the only difference is that you don't want to put beer in your boiler. This standby power information is not available on the product label, or any website I could find. There is no standardized testing, so manufacturer claims would be.... just that. Buyer Beware. The product I ultimately bought ostensibly had losses about one-fifth that of the first one, and the claimed efficiency on the heating side was virtually the same.

Although we got a boiler, we chose a system using a fan unit to heat air which then goes into a duct system (rather than using radiators) because we wanted to ensure significant warm air movement to keep the house dry in our relatively damp climate. Ducting must be the least romantic component of a "green" home. My spouse certainly isn't interested in it. It's also one of the real Achilles heels of any heating or cooling system. About \$4 billion dollars worth of energy is lost each year in the United States through poorly installed, leaky ducts. I worked closely with the heating contractor on this one. We insulated them to R-8, twice the level called for by the local codes (a very low added cost, but significant savings given that they're located in an unheated crawlspace). The contractor boasted about the care with which he does duct design and installation. But, then I found him back-pedaling: "Oh, you want those dozen large sheet metal boxes ("boots") that connect the ducts to the floor registers insulated as well?" "Yes!", said I. "Oh, OK, but it won't really save you much and I'll have to charge you extra for that." And two years after the contractor was gone, I crawled under the house to find not one but three of the big "Y's" in the duct network to have been skipped over during the insulation process. Fortunately, the contractor agreed to come back and fix it, but most homeowners would never have known.

Trust, but verify. (Written) instructions to the contractor were to insulate ALL hot water piping. On that same "crawl-through," while under the narrower part of the crawlspace tracing some lines, I found at least 30 feet of copper pipe (a perfect radiator) to be un-insulated, and duly keeping the mice comfy all winter long. And some, was, well, kind of sort of insulated....

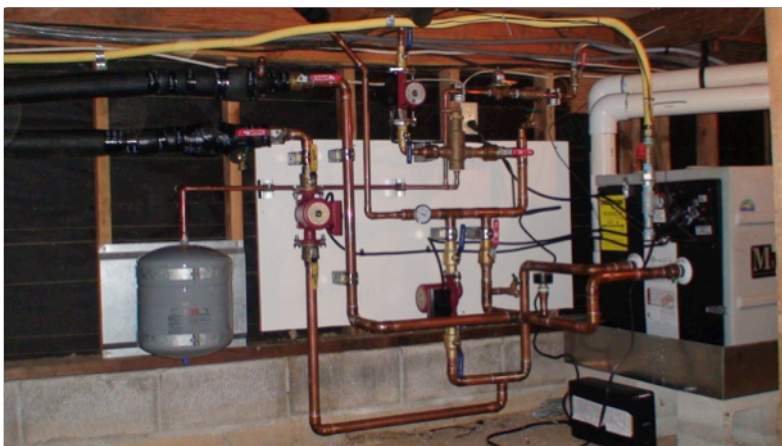


That's not the worst of it (by a long shot). Almost two years after installation, when we couldn't get the heating contractor to return calls, we had a fresh one come in to help evaluate some possible retrofits. He took one look at the boiler and said it was 50% bigger than any boiler he'd ever installed in this area. Moreover, the piping was an outmoded type that is known to leak air and eventually cause oxidation (rust) in the components. Worse of all, there was only one loop, keeping the storage tank and the air-handler unit in series rather than parallel (called for in all sample layouts shown in the boiler manual). This meant that very hot water destined for the air-side fan, essentially was pre-cooled by the storage tank (for domestic hot water) which had a setpoint far below what the fan wanted. Pumps were missing. MANY thousands of dollars later, we have a newly designed piping layout and lawyers arguing about whether the original company is liable. The boiler manufacturer hung us out to dry, supporting the HVAC contractor (his customer, after all). At least we got the Better Business Bureau to rate the contractor with a "D", for dufus. My kids don't really need braces anyway.

The original building inspection? Oh, the inspector signed off on everything.



*The first new boiler system (top) and after the second contractor got done with it (bottom, before pipe insulation).*

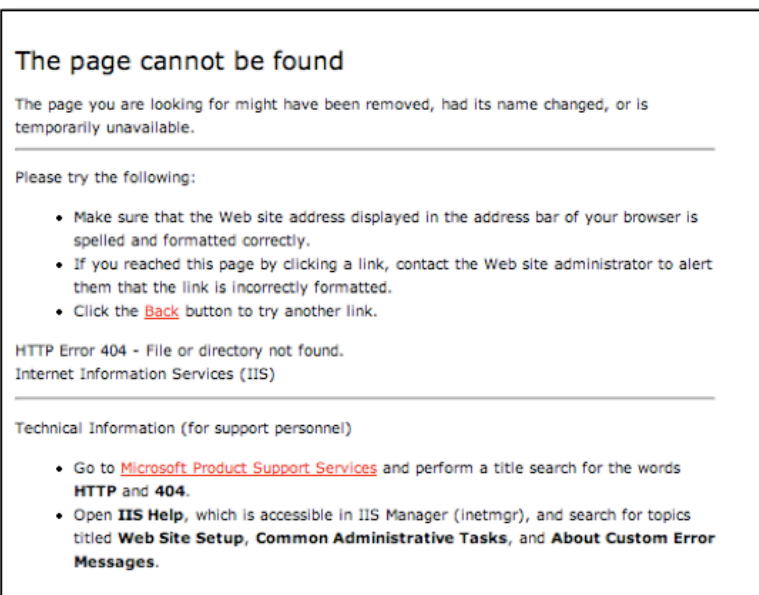


What about windows? We inherited 30-year-old dual windows, but being dual-pane was the only good thing about them. Many had failed (were fogged) and all were leaky and had icy-cold aluminum frames. I knew that we wanted low-emissivity ("Low-e" technology and argon fillings, but there are many variations to choose from. The original version of Low-e

is the best thing since sliced bread. It involves a virtually invisible hard coating on the glass that allows useful visible light in but keeps more of the invisible heat from escaping to the outside. The optional argon gas filling further impedes heat loss. Budget limitations meant we were only going to replace a couple right away, more in the future.

I learned quickly that local contractors and even the window vendors knew little (but thought they knew everything) about what the correct window choice would be for this climate and house orientation. I noticed and politely noted that the windows they were pushing were perfectly optimized for a place more like Phoenix (limiting solar heat gain and trimming air-con costs) than our foggy Northern California coast where there is no need for air-conditioning and one wants to welcome every wintertime light ray available into the home. One vendor said he'd "never had complaints". (Oh, you mean complaints by people who don't know what they're missing? Right... An inefficient window "works", it just costs you more energy than need be.) The prevailing rating system has very coarse geographical variations, but doesn't really recognize these particular climate differences.

The standard window brochures are more or less useless, unless your idea of a good time is endless foofey blue and red arrows depicting alleged heat flows.



*I went hunting for more technical window product literature. The link to numerical energy ratings from a leading manufacturer led to one of those scary "Page Cannot Be Found" errors.*

Surely, calling manufacturers directly would prove more satisfying. They told me the most remarkable things, but none of them correct. I wanted high-solar-gain windows on the south side of the house and was told that if that was the case I shouldn't get windows with Low-e. The purpose of Low-e (according to the misguided manufacture) was to "block solar gain." Well, not exactly. Yes, low-e gobbles up some of the useful solar, but you're better off picking a particular low-e product that offers relatively high solar gains than none at all. (New Low-e recipes for "cool glazings" were later devised for hot climates where solar gain could be blocked.) I also asked about having a window filled with argon gas, and was told that they are only for extremely cold climates. Argon actually pays off in a relatively mild climate like ours. Oh well. The glass I identified will actually be a net energy gainer (on an annual basis) on the south and west sides of my home. In other words, more

solar energy will enter and be retained during the day than that lost at night. Nifty – a window that is a heating system with no fuel cost. Problem is that I still can't find a window manufacturer that uses this particular glass in their assemblies. "Page Not Found...." Keep looking. Keep looking. Keep looking....

Will someone please put me out of my misery? The dryer that came with the home went on the blink. Great – another opportunity to upgrade to higher efficiency. Yes, yes, the literature says that dryer efficiency doesn't vary among products, but new testing results suggest otherwise, and that the official test procedures miss the key differences. Dryers aren't required to bear the FTC EnergyGuide label and EnergyStar doesn't rate them. Not even the manufacturers (I checked two) list the Energy Factor for their own products. Nor does anyone offer a simple calculator on how to evaluate the tradeoff between gas and electric.... Given that clothes dryers can use almost as much energy as a fridge, this is pretty scandalous. Making matters worse, we need a new dryer .... Now! .... And don't have time to launch another Manhattan Project to figure out what to do. At least we moved the original dryer out of the house and into the garage so that it no longer sucks heated air out of our home when it's running.

Bear with me a moment for one more story about energy-using devices run amok. Warning: this one is not glamorous. It's the pump and pressure-tank combination that boosts our water pressure from the local gravity-fed system. The plumber didn't bother to check the pressure in the new tank, which are typically shipped under more pressure than they should be used. The result was that the pump cycled on and off much more often than need be, with the result of not only more energy use but excessive wear and tear on the pump. While this is a relatively minor issue, it is sadly indicative of the lack of quality assurance in the way buildings are put together and tested (or not tested, as the case may be).

Speaking of water, we immediately upgraded old toilets and showerheads to water-efficient units, and landscaping has become mostly about restoration of the site with wonderful drought-resistant and local native plants. We're capturing some water from our roof for gardening and it feels good every time we use it instead of turning the tap (and saves a little pumping energy as well). Our neighborhood has its own water system, no doubt with much less embodied energy (and more pristine water) than the heavy water that was pumped hundreds of miles through hill and dale to our former house.

Yes, we want to "go solar." Remember our boiler? Well, it loads hot water into a big storage tank and we forked out for an extra coil inside waiting to receive supplementary hot water from panels. We've also interviewed a couple of solar electric system providers. Neither has been able to say how *much* energy their systems would contribute and so I haven't been able to do the cost-benefit analysis. There are also some pesky redwood trees shading parts of the roof and I have to figure out whether it is greener to leave or remove them. Not only are they redwoods (after all!), they embody tons and tons of carbon, which would turn into greenhouse-gas emissions if they were chipped rather than buried in engineered landfills or turned into lumber (it would be hard to get a crane into that area to pull out lumber-grade logs). I shudder at the thought, not to mention the guilt



and cost of removing redwoods. None of the vendors is prepared to do this ecological “cost-benefit” analysis for me.

Speaking of wood, what house would be truly “green” without bamboo flooring? I love the concept of bamboo as a green material – a fast-growing, carbon-sequestering renewable product that probably has considerably less energy embodied in its transportation when coming from China by freighter than hardwoods from the Eastern US brought by truck. We did tons of research and settled on a product that seemed credible, had certification from the Forest Stewardship Council (FSC), and the company reportedly used good labor practices in their factories in China. The first snake in the garden was a huge pile of material that was left over after the job. The vendor said 5% waste was “normal”, but I did the math and beheld 12% waste, equivalent to almost \$1,500 (green for the seller, but not me). In a very rectilinear house like ours with no diagonal cuts or irregular rooms, I bet the waste could have been reduced significantly if an effort had been made, but of course more waste means more revenue for the manufacturer, so the incentives are perverse. Anyway, the brand-new floor began warping. . . . We had no idea whether this is because it’s bamboo, or whether any wood would have done so. Problem is that all parties are working harder to deflect responsibility than to resolve the problem. It gives green a bad name.

When we purchased the house, the fiberglass bats in the subfloor were badly deteriorated and there were moisture (and rodent) issues down there. . . . Our friendly contractor assured me that no one insulates floors in this damp coastal region and that we should remove the old stuff and go without. Floor inspectors sent by the bamboo company later said that the subfloor was too moist (not to mention that the contractor had not followed manufacturers’ directions on letting the flooring acclimate before installing). Time to insulate this floor.

Closed-cell insulation offered the most promising pathway: rodent-resistant and a continuous moisture barrier. Our options were limited to a single local contractor who would install spray-foam, and, no, he wouldn’t warrant against shrinkage. Tons of penetrations made in the sills and elsewhere in the floor when the house was built 30 years ago also got sealed in the process. The home is way more comfortable now, a faint moldy smell in the rear rooms is gone, and the flooring is calming down. Oh, um, well, the contract called for two inches of foam. I even told the guy I would verify it afterwards. The first 10 measurements I took ranged from one-quarter inch to one-and three-quarters inches. There were certainly large areas with two inches, but also lots with less. I’ve paid about 40% of the final amount, and predict he won’t bother even coming back to fix it. . . .



*Examples of the penetrations in the subfloor, leading cold, damp air under the bathtub, and through myriad holes for wiring and pipes. All sealed up now, thanks the closed-cell sprayfoam*



*Paid for 2 inches of spray-foam on the subfloor. Got less. Will the contractor return my calls?*

(Note: No one in my area had done a conditioned crawlspace, and I wasn't prepared to be a guinea pig to help the contractors learn how not to do them. It's very moist here, and the prospect of keeping the crawlspace truly dry was a bit daunting.)

More materials waste. We selected a renewable cork wall covering for one area, and opted for the green-certified (no VOC's, etc.) adhesive. The standard adhesive was available in small cans, but to get the green stuff we needed to buy 4 gallons (at a pretty price of \$120)—way more than we needed—which meant at least two gallons left over with nowhere to go....

What is it about adhesive, anyway? Months after the project was over we found out that our contractor ordered but did not use 4 gallons of environmentally-friendly adhesive for the flooring. But he used staples instead and the adhesive was put in the "dump pile" (how green is that?) but fortunately recovered. By the time we got around to returning it, the vendor would not take back the "old" material...

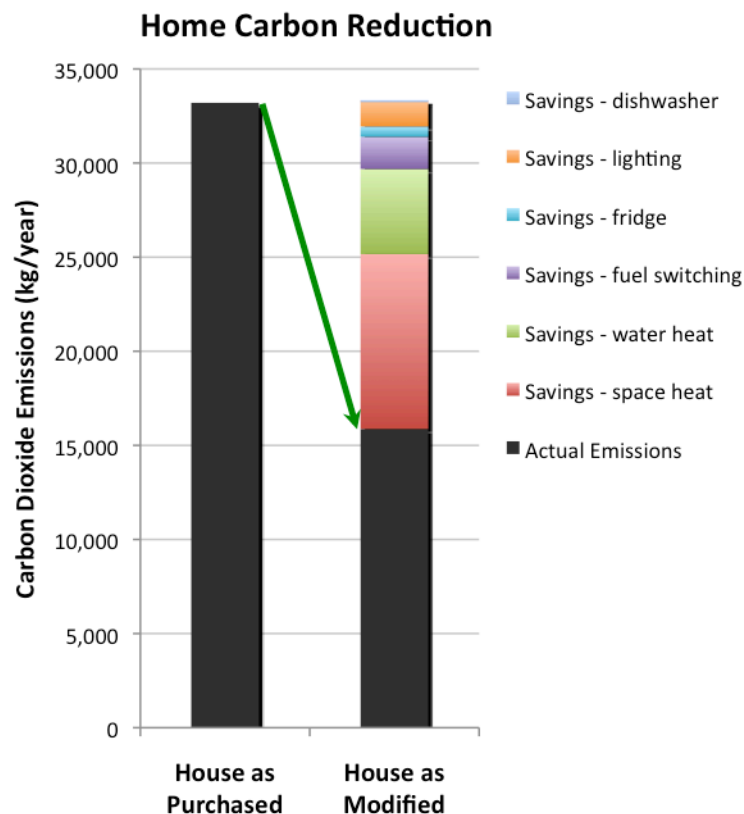
One recurring source of bewilderment throughout this process has been that virtually none of the trades people ever mentioned the various financial incentives that are out there for the taking, ranging from utility rebates to tax credits. When finally asking the contractors and trades-people (since they didn't volunteer), the response was usually blank stares. Information on this is readily available to anyone who cares. It would help the contractors sell customers their projects, but they don't bother...

Lifestyle changes have also made a difference, and, contrary to popular opinion have proven far easier for us to make than grappling with all the technologies and trades. We're in a smaller town and seem to be "consuming" less. There aren't the same temptations here, and the Joneses tend not to have even one television, let alone two. Working now primarily at home, I'm in the car less often and more of the driving is at efficient highway speeds and virtually no traffic jams. My hybrid car averaged about 33 mpg before the move. I'm now getting 43 thanks to a higher proportion of highway time. Monthly commutes to the big city have increased mileage slightly, but overall carbon emissions are lower by about a ton per year thanks to the better fuel economy. For the minivan (sorry, we've got 3 kids) fuel economy has increased from 16 to 22 mpg thanks to virtually no driving in traffic.

Last, but not least, we chose to buy an existing home and bring it back to life a bit after more than a little deferred maintenance. It feels good to have "recycled" rather than building new.

In spite of the monumental inertia outlined in the preceding pages, we've put a major dent in our carbon footprint. So far, we have reduced the carbon-dioxide emissions associated with our home's energy use by half compared to what it would have been had we not made any of the modifications. Attacking the next half will be an even bigger challenge, but we'll persevere. But, with so many sales- and trades-people and product suppliers flying blind on green, mainstream consumers would have given up long ago. No wonder the glaciers are melting.

The world's collective lofty ambitions for energy and climate are the right ones, and a new day has dawned among policymakers who have a lot of catching up to do. But if they ignore the potholes and speed bumps that everyday consumers have to contend with on the road to green, they'll fall far short of their goals.



The house is relatively large (about 2700 square feet, and occupied by two adults and three children). Both adults work at home, so the “operating hours” are higher than a typical home (but, in turn, no energy is used in outside offices).

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**Special Note for Climate Deniers:** You will no doubt have read this report with relish, but the message is *not* that “green” will fail. Homes and other types of buildings can be made carbon-neutral, and indeed many already have. We reduced our footprint by 50%, which is about 10-times what the Kyoto Protocol calls for. The barriers are not intrinsic in the technology; they are in your beloved markets. Market failures are behind all of the problems cited above. By making markets function better, the right information will flow to decision-makers, energy will be priced at what it costs (a concept that has not ever been tried) the right skills will be fostered in the workforce, and undistorted economics will prevail. These are messages that can and should transcend ideology and partisan interests.